was 29.38 inches (uncorrected), occurring at 7:35 a. m. on the 7th in 55° 51′ S., 66° 12′ W. The wind at the time was NW., force 8.

A report of the second gale was received from the British S. S. *Waikawa*, Suva, Fiji, to Vancouver. The observer, Mr. J. Haultain, states that a fresh gale began on the 12th, accompanied by a heavy confused sea and rain squalls. The lowest barometer recorded was 29.78 inches (uncorrected), this occurring at 3:15 a. m. on the 13th in 13° 37′ S., 177° 5′ W. The wind at this time was ESE., force 8. This gale lasted throughout the evening of the 13th and during that time the wind increased to force 9, with shifts from the SE., ESE., E., and ESE.

South Atlantic Ocean.—Of the cyclonic disturbances occurring in the South Atlantic Ocean during September, only one of any significance has been reported. This was a depression which appeared on the 14th off the coast of Uruguay and which until the 16th occasioned moderate to whole gales with heavy rain squalls and rough seas. The Danish S. S. *Oregon*, Capt. W. Muhldorff, Cardiff to Bahia Blanca, came within its influence on the 14th. Mr. L. Olsen, second officer, reports that the lowest pressure was 29.84 inches, occurring at 4 p. m. on the 15th in 33° 59′ S., 51° 40′ W. The wind which at this time was NNE., force 8, later shifted to E. and increased to force 9–10.

On the 16th the Dutch S. S. *Alchiba*, Capt. K. E. Dik, Rotterdam to Buenos Aires, encountered the same gale in 34° 30′ S., 53° 14′ W., reporting conditions similar to those experienced by the *Oregon*. Mr. J. P. Nieman, observer, states that the lowest barometer, 29.80 inches, was recorded at 8:28 a. m. on the 16th. The wind at this time was NW., force 7–8.

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

ALFRED J. HENRY

The month may be characterized as cool east of the Rocky Mountains, warm west; heavy rains on the closing days in Atlantic coast districts, severe drought in Louisiana, parts of Texas and Mississippi, and deficient precipitation generally in the Rocky Mountain, and plateau regions, also in California, Nevada, eastern Washington, and eastern Oregon.

The usual details follow:

CYCLONES AND ANTICYCLONES

By W. P. DAY

The month was dominated by high-pressure areas, not of the swiftly moving cool-wave types, but areas of relatively high pressure generally moving in from the Pacific, becoming greatly enlarged and very persistent through frequent reinforcement from the Canadian interior. This condition was most noticeable during the second and third decades and the movement of LOWS was affected by it. That is, the polar-equatorial interchange of air was more north-south, the HIGHS being so frequently revived that they interfered with the normal easterly drift and the warm air of the Tropics moved northward between such high pressure systems in troughs or in more temporary formations of a definite cyclonic nature.

Two fully developed hurricanes were charted during the month. The first had been followed during the last days of August as it passed northwestward over the Leeward and Virgin Islands, but was not definitely located again until the 2d of September when it was about 400 miles southwest of Bermuda. Lack of reports again prevented a full knowledge of its movements until it reached the steamer lanes south of Halifax on the morning of the 4th and the south coast of Newfoundland the same evening. The second hurricane developed over the eastern portion of the Gulf of Mexico and had attained considerable intensity when it struck a small section of the Florida coast near Appalachicola.

FREE-AIR SUMMARY

By L. T. SAMUELS, Assistant Meteorologist

It is found from kite observations that the negative temperature departures at the surface for the month over the country east of the Rocky Mountains either decreased in magnitude or changed to positive with increase in elevation above the ground. The northern and eastern stations showed the strongest tendency toward maintaining relatively low mean temperatures in the upper levels. Notwithstanding this fact, the resultant winds for the month as determined from kite observations at Ellendale and Royal Center, two of the stations referred to above, had a larger southerly component and at Due West a smaller northerly component than the normal. This appears paradoxical unless we consider the relatively small resultant velocities usually obtained during a month where the ordinary procession of HIGHS and LOWS causes a continuous succession of northerly and southerly winds. As a rule the resultant winds for a month as determined from pilot-balloon observations agree closely with those found by kites. However, when the observations are not similarly distributed, as occurred this month at Due West, large differences are frequently found. For example, at the 1,500-m. level at this station the resultant wind determined from pilot-balloon observations was N. 73° W. 3.8, whereas that from kite observations was S. 84° E. 3.2, almost diametrically opposite, and yet of significant velocities. The cause of this difference is at once apparent when we learn that balloon and kite observations were possible on the same day only five times during the month, weather conditions prohibiting either one or the other or both on the remaining days.

The effects of the increasingly longer nights, especially at the more northern stations, become apparent at this season of the year in the temperature lapse-rates above the earth's surface. It is interesting to note the lati-

tudinal variations in the normal lapse-rates for September for the first 1,000 m. above the ground.

Station	Decrease in temperature (°C.) from surface to 1,000 m.
Ellendale	3.3
Drexel	4.3
Broken Arrow	5.6
Groesbeck	6.7
Royal Center	7.0
Due West	6.9

The consistent increase with decreasing latitude is clearly brought out in these figures, as are the comparatively large lapse-rates for the two eastern stations. The cause of the latter is to be found in a combination of factors, such as the later average hour of making kite flights, the warming effect produced in the lower levels of HIGHS before reaching these stations, the different source of the southerly air in a LOW at these stations from that of the western stations, etc.

In general, the relative humidity departures for the month were of opposite sign with respect to those for temperature and vapor pressure, as is usually found. (See Table 1.)

The high pressure area central over the middle of the country on the 29th brought the lowest temperatures for the month at Ellendale and Drexel on that date, and on the 30th at the other four stations. These abnormally low temperatures extended to considerable heights at all six stations, breaking previous minimum temperature records for October at various altitudes reached by the kites at Broken Arrow, Due West, Groesbeck, and Royal Center.

Fortunately there was obtained simultaneously at Ellendale and Royal Center a series of kite flights extending at the former station from 7:13 a. m. September 30 to 11:44 a. m. October 1 and from 7:19 a. m. September 30 to 10:30 a. m. October 1 at the latter station. During the course of this series Royal Center experienced the passage of the center of an elongated HIGH while Ellendale was in the path of an approaching LOW.

An examination of the first flight at Royal Center reveals a vertical temperature gradient for the first 1,000 m. exceeding the adiabatic rate for dry air. The wind was from the north and there were two-tenths A. St. clouds when the flight was started. Owing to this strong vertical temperature gradient the sky became nearly overcast with St. Cu. clouds within two hours, the tops of which coincided with the bottom of the inversion layer. The wind remained north throughout the inversion. The clouds were at first shallow but thickened steadily from 250 m. to 1,200 m. by 5 p. m. It is interesting to note the coincident thickening of the cloud layer with the increasing elevation of the inversion, the tops of the clouds always reaching to the beginning of the inversion. A trace of rain fell at Royal Center when this cloud reached its maximum thickness. By 8 p. m. the HIGH had moved southward and was central over the lower Mississippi Valley. At this time the surface wind at Royal Center became WSW. and the upper winds WNW. and NW. A tremendous warming aloft occurred with the arrival of this westerly air and indicated plainly its totally different origin. The greatly increased temperatures found above the surface, and the time interval between the observations are shown in the following table, which represents the descent of the third flight and the ascent of the fourth.

Altitude (m.) M. S. L.	Temperature change (°C.)	Time interval between observations (hrs.)
225 (surface)	−1.5	4
500	+1.9	4
1,000	+1.9	5
1,500	+3.8	7
2,000	+7.9	7
2,243	+8.8	7

The time intervals are those necessitated in making the flights, but it is reasonably certain that the actual time required for the changes was even less than that shown in the table. Such large temperature changes in the short intervals at these elevations are of great significance in the consideration of air trajectories. The fact that a south component is not always necessary for an appreciable rise in temperature is in this case well demonstrated. The cloud layer referred to above was quickly dispelled by the invasion of this warmer air and the sky remained cloudless for several hours when a few Ci. and Ci. St. appeared from the west.

At Ellendale where a series was made during this same period the conditions were of course totally different. This station was in the rear of the HIGH and experienced conditions incident to the approaching LOW, although the center of the latter had not reached Ellendale by the end of the series. The surface winds here remained practically south during the series while the upper winds backed from WNW. at the beginning to WSW., at the end of the series. The temperature rose, level for level, during the series, above the heights to which the nocturnal inversions extended.

The relative humidity throughout the series decreased with elevation, being around 30 per cent at the highest levels (4,000 m.). This is characteristic of LOWS in this region where the absolute humidity of the relatively warm air is low and therefore clouds of the lower type are usually absent.

An interesting occurrence showing the extensive proportions of relatively thin air currents occasionally found was revealed in kite records of the 18th from Ellendale, Drexel, and Broken Arrow, a flight at Groesbeck being prevented by rain and light wind. On this date the stations named above were within a region of nearly straight N–S. isobars between an ill-defined HIGH central over the Great Lakes and an elongated LOW central over the eastern slope of the Rocky Mountains. The winds at Ellendale were SSE. to the highest levels reached (3,010 m.), at Drexel SSE. veering to SW. at the highest level (3,655 m.), and at Broken Arrow SE. veering to SW. at the highest level (3,678 m.). At about the 2,500-m. level there was found at all three stations a sharply defined layer of warm air causing a pronounced inversion.

Within this warm current the relative humidity dropped from saturation to 34 per cent at Ellendale, 22 per cent at Drexel, and 43 per cent at Broken Arrow. Following are the data showing the thickness of this layer and the temperature differences found at its upper and lower boundaries at each of the stations.

Station	Altitude (m.) of lower boundary and temperature (°C.)	Altitude (m.) of upper boundary and temperature (°C.)
Ellendale	2,296 2.1	2,524 5.8
Drexel	2,652 −1.4	2,724 4.6
Broken Arrow	2,252 6.6	2,496 12.3

The records from Royal Center on the 28th and 29th afford an excellent example of a slow-moving wedge of cold northerly air underrunning a rapidly moving current from the south. The following table gives the temperatures and winds at Royal Center on these dates.

Altitude M. S. L.	Temperature (°C.) 28th	Temperature (°C.) 29th	Wind 28th	Wind 29th
225 *meters* (surface)	10.3	6.8	NW.	N.
1,000	5.1	2.7	WNW.	NNE.
1,500	4.5	−0.7	WSW.	N.
2,000	4.0	−2.0	WSW.	NNW.
2,500	3.2	−3.0	WSW.	N.
3,000	5.1	----------	SW.	W.
3,500	1.4	----------	SSW.	WSW.

The progressively increasing height of the northerly current is clearly shown and while the kite and balloon observations did not extend higher than indicated in the above table, there were observed on the 29th 6/10 A Cu clouds moving from the SE. That this upper southerly current was comparatively warm is revealed in the above listed temperatures of the 28th, which show that the temperature at 3,000 m. was the same as that at 1,000 m. Such a stable condition was, of course, not conducive to rain.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during September, 1924*

TEMPERATURE (°C.)

Altitude m. s. l. (*m.*)	Broken Arrow, Okla. (233 *m.*) Mean	Departure from 7-yr. mean	Drexel, Nebr. (396 *m.*) Mean	Departure from 9-yr. mean	Due West, S. C. (217 *m.*) Mean	Departure from 4-yr. mean	Ellendale, N. Dak. (444 *m.*) Mean	Departure from 7-yr. mean	Groesbeck, Tex. (141 *m.*) Mean	Departure from 6-yr. mean	Royal Center, Ind. (225 *m.*) Mean	Departure from 7-yr. mean
Surface	20.4	−2.7	16.4	−2.1	20.3	−2.8	12.6	−2.1	22.0	−2.3	17.1	−3.9
250	20.3	−2.6	----	----	19.7	−3.0	----	----	21.7	−2.0	16.8	−4.0
500	18.7	−2.6	16.0	−2.1	17.3	−2.9	12.5	−2.2	21.1	−1.2	14.3	−4.2
750	17.4	−2.6	14.5	−2.5	15.5	−2.9	11.8	−2.3	20.0	−0.9	12.5	−4.3
1,000	16.3	−2.4	13.2	−2.8	14.6	−2.6	11.2	−2.0	18.8	−0.9	10.8	−4.4
1,250	15.6	−1.8	12.3	−2.6	13.8	−2.3	10.7	−1.6	17.8	−0.6	9.2	−4.5
1,500	14.9	−1.2	11.2	−2.5	12.8	−2.0	9.5	−1.7	16.9	−0.4	7.7	−4.5
2,000	13.3	−0.3	9.6	−1.5	10.3	−1.9	6.5	−2.1	15.3	+0.3	5.6	−4.0
2,500	11.1	+0.3	7.2	−0.8	7.6	−1.7	3.9	−1.8	13.4	+0.9	2.9	−4.1
3,000	8.7	+0.8	5.2	+0.2	5.0	−1.5	1.5	−1.3	11.9	+1.9	2.2	−2.4
3,500	5.6	+0.9	2.5	+0.4	2.2	−1.5	−1.2	−1.3	9.8	+2.3	−0.6	−2.6
4,000	1.9	+0.3	0.1	+0.8	−2.3	−2.2	−3.8	−1.3	7.0	+2.3	----	----
4,500	−1.2	0.0	−2.3	+1.3	−4.9	−1.4	----	----	4.2	+2.2	----	----
5,000	----	----	----	----	----	----	----	----	1.3	+1.5	----	----

RELATIVE HUMIDITY (%)

Surface	68	0	66	+1	72	+6	71	+5	72	−4	70	+5
250	68	0	----	----	73	+7	----	----	69	−7	70	+5
500	66	0	63	0	75	+5	70	+5	64	−11	70	+5
750	64	0	62	+2	76	+4	66	+4	64	−11	71	+6
1,000	63	0	62	+4	75	+4	64	+4	61	−11	73	+8
1,250	59	−3	59	+3	75	+6	61	+4	57	−13	76	+11
1,500	54	−5	59	+4	81	+11	61	+6	51	−16	77	+13
2,000	45	−9	56	+3	79	+14	65	+13	47	−15	60	+1
2,500	43	−7	58	+4	82	+17	61	+10	44	−12	56	+1
3,000	42	−7	49	−4	84	+22	57	+6	35	−17	50	−1
3,500	44	−8	45	−6	87	+27	53	+4	32	−17	52	+4
4,000	50	0	44	−6	89	+22	54	+8	28	−18	----	----
4,500	49	0	42	−9	88	+21	----	----	26	−20	----	----
5,000	----	----	----	----	----	----	----	----	25	−19	----	----

VAPOR PRESSURE (mb.)

Surface	16.09	−3.06	12.30	−1.78	17.16	−1.51	10.21	−0.89	19.38	−3.65	13.85	−2.37
250	15.97	−3.05	----	----	16.87	−1.57	----	----	18.44	−3.78	13.62	−2.39
500	14.23	−2.77	11.63	−1.82	14.94	−1.92	9.98	−0.94	16.49	−3.77	11.77	−2.44
750	12.67	−2.58	10.44	−1.61	13.64	−1.92	8.96	−1.02	15.21	−3.22	10.58	−2.27
1,000	11.71	−2.21	9.51	−1.41	12.81	−1.51	8.13	−0.91	13.71	−2.70	9.74	−1.95
1,250	10.66	−1.92	8.51	−1.39	12.07	−0.92	7.40	−0.67	12.15	−2.61	9.02	−1.51
1,500	9.29	−1.78	7.83	−1.07	11.84	−0.17	6.86	−0.42	10.34	−2.73	8.29	−1.14
2,000	6.91	−1.50	6.35	−0.91	9.70	+0.03	6.02	+0.12	8.41	−1.85	5.73	−1.52
2,500	5.60	−0.65	5.35	−0.68	8.26	+0.23	4.73	−0.17	7.04	−0.88	4.29	−1.18
3,000	4.50	−0.32	4.05	−0.88	6.93	+0.28	3.71	−0.46	5.27	−0.97	3.13	−0.85
3,500	3.72	−0.34	3.20	−0.78	6.52	+0.71	2.95	−0.55	4.47	−0.63	2.23	−0.70
4,000	3.32	+0.26	2.73	−0.60	6.05	+0.59	2.63	−0.30	3.65	−0.44	----	----
4,500	3.10	+0.64	2.26	−0.56	5.64	+0.62	----	----	3.11	−0.44	----	----
5,000	----	----	----	----	----	----	----	----	2.97	−0.16	----	----

TABLE 2.—*Free-air resultant winds (m. p. s.) during September, 1924*

Altitude, m. s. l. (*meters*)	Broken Arrow, Okla. (233 meters) Mean Dir.	Vel.	7-year mean Dir.	Vel.	Drexel, Nebr. (396 meters) Mean Dir.	Vel.	9-year mean Dir.	Vel.	Due West, S. C. (217 meters) Mean Dir.	Vel.	4-year mean Dir.	Vel.	Ellendale, N. Dak. (444 meters) Mean Dir.	Vel.	7-year mean Dir.	Vel.	Groesbeck, Tex. (141 meters) Mean Dir.	Vel.	6-year mean Dir.	Vel.	Royal Center, Ind. (225 meters) Mean Dir.	Vel.	7-year mean Dir.	Vel.
Surface	S. 56°E.	1.4	S. 2°E.	3.1	S. 29°E.	1.0	S. 10°W.	1.7	N. 55°E.	3.7	N. 62°E.	2.7	S. 40°W.	1.1	N. 1°W.	0.8	N. 89°E.	0.8	S. 27°E.	1.7	S. 39°W.	0.2	S. 54°W.	1.4
250	S. 56°E.	1.5	S. 2°E.	3.2	----	----	----	----	N. 60°E.	3.8	N. 62°E.	2.6	----	----	----	----	S. 69°E.	0.9	S. 24°E.	2.4	S. 26°W.	0.4	S. 50°W.	1.6
500	S. 47°E.	2.0	S. 6°W.	4.4	S. 29°E.	2.1	S. 8°W.	2.4	N. 52°E.	3.9	N. 57°E.	2.8	S. 35°W.	1.4	S. 77°W.	0.9	S. 19°E.	1.5	S. 14°E.	3.7	S. 30°W.	2.7	S. 47°W.	3.2
750	S. 38°E.	2.3	S. 13°W.	5.0	S. 1°E.	3.6	S. 22°W.	3.7	N. 72°E.	6.5	N. 64°E.	3.5	S. 32°W.	3.0	S. 60°W.	1.8	S. 3°E.	1.8	S. 8°E.	4.0	S. 43°W.	4.2	S. 56°W.	4.2
1,000	S. 6°E.	1.2	S. 24°W.	4.7	S. 1°W.	4.0	S. 31°W.	4.0	N. 84°E.	6.2	N. 69°E.	3.3	S. 32°W.	3.6	S. 64°W.	2.6	S. 5°W.	2.2	S. 7°E.	4.2	S. 54°W.	4.5	S. 64°W.	4.8
1,250	S. 63°W.	1.4	S. 31°W.	4.7	S. 31°W.	4.3	S. 47°W.	4.3	N. 68°E.	5.3	N. 52°E.	3.3	S. 38°W.	3.1	S. 68°W.	3.0	S. 4°W.	1.9	S. 7°E.	4.2	S. 59°W.	6.0	S. 68°W.	6.0
1,500	S. 86°W.	2.5	S. 42°W.	4.8	S. 41°W.	5.7	S. 58°W.	4.9	S. 84°E.	3.2	N. 54°E.	2.5	S. 44°W.	3.0	S. 76°W.	3.7	S. 19°W.	1.3	S. 6°E.	4.0	S. 70°W.	5.8	S. 73°W.	6.4
2,000	S. 88°W.	4.8	S. 51°W.	5.6	S. 79°W.	5.8	S. 70°W.	5.8	S. 69°E.	3.4	N. 56°E.	1.8	S. 58°W.	2.6	S. 79°W.	4.9	S. 62°W.	0.9	S. 3°E.	3.5	S. 75°W.	4.6	S. 74°W.	8.2
2,500	S. 85°W.	6.3	S. 61°W.	5.2	S. 85°W.	6.7	S. 77°W.	7.4	S. 47°E.	2.8	N. 55°E.	1.2	S. 80°W.	3.5	S. 85°W.	6.8	N. 42°W.	1.8	S. 6°E.	3.4	S. 40°W.	5.8	S. 74°W.	9.6
3,000	N. 87°W.	6.8	S. 54°W.	6.0	S. 86°W.	9.3	S. 83°W.	9.3	S. 64°W.	6.2	N. 35°W.	0.2	N. 73°W.	4.9	W.	8.6	N. 37°W.	1.9	S. 6°E.	3.4	S. 23°W.	13.5	S. 70°W.	12.4
3,500	S. 85°W.	8.5	S. 62°W.	5.8	N. 88°W.	12.3	N. 88°W.	10.7	N. 86°W.	11.4	N. 34°W.	2.0	N. 50°W.	7.2	N. 89°W.	10.0	N. 6°W.	3.0	S. 2°E.	2.7	S. 12°W.	17.8	S. 78°W.	12.3
4,000	N. 78°W.	13.0	S. 81°W.	8.0	N. 83°W.	11.7	N. 77°W.	12.0	N. 86°W.	11.4	N. 24°W.	2.0	N. 30°W.	8.5	N. 75°W.	11.7	N. 2°E.	3.7	S. 4°E.	2.7	----	----	----	----
4,500	N. 77°W.	16.3	N. 64°W.	11.5	S. 86°W.	9.2	N. 71°W.	12.9	N. 67°W.	13.0	N. 11°W.	7.3	S. 23°W.	13.9	N. 73°W.	12.8	N. 10°E.	1.2	S. 1°E.	4.4	----	----	----	----
5,000	----	----	----	----	----	----	----	----	N. 67°W.	11.5	N. 3°W.	7.1	----	----	----	----	S. ----	1.7	S. 24°E.	4.4	----	----	----	----